ECONOMY AND ENVIRONMENT PROGRAM FOR SOUTHEAST ASIA

Understanding Household Demand for Water: The Metro Manila Case

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UNDERSTANDING HOUSEHOLD DEMAND FOR WATER: THE METRO MANILA CASE*

Cristina C. David and Arlene B. Inocencio**

1. INTRODUCTION

Widespread water shortages in Metro Manila have made the urban water problem a central policy issue. President Ramos recently called a "Water Summit Meeting" and directed all concerned agencies to develop a short- and medium-term strategy for addressing the impending water crisis. In Congress, the Water Crisis Act was passed which empowered the President to contract new water supply projects expeditiously, bypassing the normal bidding procedures. About $7 million is being spent to develop an action program to privatize the Metro Manila Waterworks and Sewerage System (MWSS). And with the widespread perception of gross inefficiency and graft and corruption of the MWSS, its administrator and some of its Board members have been replaced by credible professionals from outside the agency.

Comparison with the public waterworks system in other ASEAN countries indeed show the weak performance of the MWSS (Table 1). Only 69% of the MWSS service area is covered by piped water connection, compared to 79% in the public waterworks in Bangkok and 100% in those of Kuala Lumpur and Singapore. In terms of number of house connections per capita, the gap between Manila on the one hand and Bangkok, Kuala Lumpur, and Singapore on the other hand is even much wider.

Jakarta has the lowest service coverage in terms of percentage of service area and house connections per capita. However, in terms of measures of inefficiency (i.e., ratio of non-revenue water, hours of water availability, and number of personnel per 1000 connection), Manila has the worst record of all. On the average, MWSS provides water for only about 18 hours per day, whereas piped water service is available 19 hours a day in Jakarta and 24 hours in the other cities. MWSS's efficiency and financial performance also greatly suffers from over-manning as indicated by the high ratio of staff personnel to the number of connections: six times more than Singapore and Kuala Lumpur, and double that of Bangkok.

The most dramatic evidence of MWSS inefficiency is the high ratio of non-revenue water (NRW) or water that is not accounted for due to illegal connections, leakages, and others. Nearly 60% of water produced by MWSS is not billed or is not accounted for. In contrast, NRW is only 8% in Singapore (one of the lowest worldwide); and about 30% in Bangkok which is about the average among developing countries. Efforts to reduce the high rate of NRW has largely failed, as annual non-revenue for water has risen by 276% since the mid-1960's (World Bank 1980). In fact, increases in

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water produced by the series of major investments of MWSS over the past 25 years have been almost entirely lost as NRW. A recent foreign loan from the Asian Development Bank to reduce the high rate of NRW was suspended because of the failure of MWSS to achieve planned reductions.

Because of MWSS's inability to provide water to nearly 40% of its service area, widespread water rationing in many parts of Metro Manila, and the much higher water charges for industrial and commercial establishments, private extraction of groundwater resources has grown rapidly. About 80% of industrial establishments rely solely on their own tubewells (JICA 1992). As early as 1980, groundwater was reported to account for about 40% of water supply and that rate is expected to be currently higher. With the unregulated and essentially free use of groundwater, extraction rate greatly exceeds the natural recharge, lowering the groundwater table and causing the progressive salinization of the aquifer, particularly in coastal areas (Monasinghe 1990; JICA 1991; Liongson et al. 1993; Roca 1993).

While the government has begun taking concrete steps to address the urban water issues, designing the appropriate policy and institutional framework and action programs is severely hampered by limited empirical analysis. These are necessary in improving policies and programs related to water pricing of public waterworks, pricing and regulation of groundwater extraction, demand management or water conservation, provision of water in squatter areas, private water vending, and so forth.

Most studies related to urban water issues have been feasibility studies undertaken in preparation for water supply construction loans from multilateral/bilateral agencies. There have been a few household-level demand studies, but these were usually conducted in relation to health, nutrition, poverty, and urban studies. All were descriptive and most of them have simply documented the sources of water supply. A number of studies have been conducted on willingness to pay for water and sewerage studies, but these were conducted mostly outside Metro Manila. Efforts to quantify the rate of over-extraction of groundwater resources in Metro Manila have not yet led to definitive estimates of their economic cost.

A key policy question in designing urban water policy and institutional reforms is what should be the appropriate structure of water use charges to ensure long-term sustainability of water supply. Since water pricing is a politically sensitive issue, the equity issue and consumers' willingness to pay are equally important concerns. Moreover, even with a privately managed MWSS, the government will have to regulate water tariffs because of the natural monopoly nature of water production and distribution.

In order to determine optimal pricing policies, estimates of demand and supply functions for water are required. This study focuses on understanding the nature of household demand for water in Metro Manila, including estimation of household demand functions for water. Specifically, the objectives of this study are to characterize the household sources of water supply, quality of water service, cost of water, and levels of water demand in relation to household income, and to draw some policy implications based on cross-section household survey data.

2. THE DATA

The study is based on a survey of 506 households conducted in Metro Manila during mid-1995. The survey covered 95 barangays in 11 major cities and municipalities. Appendix Table 1 lists by barangay the number of households interviewed for each sample.

The selected barangays are representative of the different types (MWSS, private waterworks, individual tubewells, private water vending) and qualities (e.g., water pressure, time availability) of water service, and the various household income levels (i.e., low, middle, high incomes) within each municipality. The barangays were chosen after a brief reconnaissance survey, an examination of the water pressure map of the MWSS, and a review of various profile studies on urban poverty. Barangay captains were first interviewed to learn about the sources of water supply, nature of private water vending, and characteristics of households in their respective jurisdictions. Based on that information, about 5 to 10 households in each barangay were selected and interviewed. Again, the households were chosen such that there would be representatives for each type of water source and for various income levels existing within each barangay. Because interviews with high income households can only be conducted through personal relationships, the sampling procedure was not strictly followed in some cases. In general, fewer households were interviewed in high-income barangays.

The household questionnaire consisted of six sections. Sections 1 to 5 covered information such as age, educational attainment, and occupation of both the respondent and spouse; characteristics of residence; inventory of water- using fixtures and appliances; price, quantity, and quality of water service; uses of water from various sources; water conservation and sanitation practices; and household income and assets. The last section included a series of questions to solicit the respondent's willingness to pay for better quality of water service.

3. CHARACTERISTICS OF WATER SUPPLY AND DEMAND

3.1 Sources of water

A wide array of mechanisms has been adopted by the general public to cope with the limited supply of water delivered by the government through the MWSS. These range from capital investments for private waterworks systems, individual tubewells, booster pumps, and storage tanks, to water delivery through private water markets. However, there is no available systematic information about the extent and nature of these mechanisms. The usual information available would be like Appendix Table 2, showing the distribution of households in the National Capital Region by source of water based on the 1990 Population Census. Not only is this table a crude characterization of the nature of water supply, the importance of private tubewells and private water vending seems very much understated and the fact that households use two or three sources is not indicated.

Table 2 presents the distribution of households by source of water based on the survey. At least 40% of households obtain water outside the formal MWSS piped water

connection system. The approximately 60% of the households who have MWSS connection, is lower than the officially reported MWSS service area coverage of about 70%. Almost 10% of households with MWSS connections supplement their water supply through tubewell pumps and private water vendors. They are part of the 10% of households relying on 2 or even 3 sources of water. A few others have installed booster pumps, particularly among high income families suffering from low or moderate water pressure. In small pockets of areas in Manila proper, Makati, and Quezon City, 6% of households have both water and sewerage connection from MWSS. Besides MWSS consumers, another 10% of households have piped water connections using private waterworks systems and deep or shallow tubewells. These households are mostly found outside the MWSS service area.

Not so well recognized is the fact that nearly 30% of households rely fully or mostly on vended water for their water supply. A small proportion of vended water is delivered in containers brought by carts, bicycles, or jeepneys, and in tanks on trucks. The majority of vended water is picked-up by consumers mostly from other households. A few consumers are from cooperative-managed public faucets, and they use 5-gallon plastic containers or 3-gallon plastic pails. A significant proportion of vended water is distributed through plastic pipe connections from other households or MWSS water mains, and consumers are billed a fixed charge. Vended water may also be delivered through plastic pipes from other households but paid for on a container basis.

An important (and unfortunate) finding of this study is that over 80% of households relying on vended water (or about 25% of sample households) are actually buying MWSS water indirectly. In most squatter colonies, particularly in Quezon City where vast tracks of public lands exist, there is an open system[1] of obtaining a plastic hose connection by attaching to a water main line or government building for a connection fee and a monthly fixed charge usually based on the number of outlets and household size. Often, households with such plastic hose connection also distribute water to other households by charging on a container basis.

Most vended water picked up by consumers is purchased from households with legal or illegal MWSS connections. Because of the progressive nature of the household water tariff structure, and the ease of tampering with water meters and bribing water bill collectors, households selling MWSS water from legal connections have water meters that are most likely tampered.[2] Again, because water vending activities across households are quite visible, those households with tampered meters can easily be identified. Given the relatively high proportion of households buying privately vended MWSS water (25% compared to 60% with MWSS connection), a significant proportion of non-revenue water is not actually lost, but paid for by the final consumers. The study also found out that vended water is sold through a well-organized, informal, and relatively open system of illegally distributing MWSS water. Although not systematically documented in the survey, also encountered were several easily detectable cases of illegal connections and indirect use of MWSS water by households. For example, a

[1] It is an open system in the sense that everyone in the community including the barangay captain, know how, for how much, and from whom to obtain that illegal water connection. There is also a well-organized monthly collection system. MWSS officially requires proof of ownership of land or permit from landowner to apply for a water connection.

[2] This is clearly evident from the failure to successfully interview any of those households.

commercial 2-storey building along a major highway removed its water meter and has not paid for its water for nearly a decade. In a high income subdivision, the subdivision association itself administers truck delivery of water originating from a fire hydrant (without any meter) located in the low-areas because of the severe lack of water supply in the elevated areas. Thus, the poor water service itself is exacerbating the problem of high non-revenue water.

3.2 Water source and tenure

Table 3 shows the distribution of households by water source according to residential tenure. Most of the households with piped water connection from MWSS, private waterworks systems, and tubewells own or rent their house and lot. It is surprising to find, however, that about 30% of households with MWSS connections are squatters. Although some squatters on private land may be using old water connections, a significant proportion (say 20% to 25% of MWSS connections) appears to have not followed official rules. In Makati, it is common knowledge that such connections can be obtained for about ₱25,000, in contrast to about ₱2,300 for a legal connection.

With the exception of delivered water, water vending is prevalent in squatter areas. The use of plastic hose to deliver water is more widespread among squatter colonies located in public lands, where large contiguous squatter areas make hose connections from water mains or government buildings feasible and economical. Water sold in containers by other households are more popular among squatters in private land because they are typically located in small pockets within non-squatter residential areas with MWSS water connections. Close to 60% of households buying delivered water own their house and lot, but usually in areas not covered by MWSS, areas where water from MWSS or private waterworks is severely rationed, or areas where the cost of using groundwater is extremely high.

3.3 Water source and income

In Table 4, the distribution of households using the different water sources by income class is presented. Households using MWSS water are normally distributed with the highest number (25%) having annual household income within the ₱60,000-₱99,999 range. Households relying on private waterworks and individual tubewells generally belong to higher income brackets. In contrast, households dependent on vended water are predominantly characterized by low incomes. Whereas 43% of households with MWSS connections have annual household income below P100,000, this figure is from 65% to 100% among households using vended water or public faucets (except those using delivered vended water). It should be emphasized that about three fourths of low-income households with MWSS connections may have illegally obtained those connections.

3.4 Water source and consumption

The relative poverty of households relying mostly on vended water can also be gleaned from the distribution of households with different water sources by their levels of water use (Table 5). Average consumption of water by MWSS households (32 cubic meters per household or 6 cubic meters per capita) is about five times that of poorer

households dependent on vended water. Only about 10% of MWSS households use less than 10 cubic meters, considered the lifeline level, while nearly all of the households using vended water belong to that category. Average consumption of households relying on private waterworks is higher than MWSS households mainly because of higher average incomes. However, average consumption of households with individual tubewells is lower than both due to the high cost of small-scale extraction of groundwater. As would be shown in a later section, households dependent on vended water suffer from both low income and high cost of vended water.

3.5 Water source, availability and pressure

Quality of water service is judged by both its time availability and degree of water pressure (Tables 6 and 7). Less than 60% of households with MWSS connections receive water throughout the day. In fact, in 30% of these households, water flows for less than 12 hours a day. On the average, MWSS provides water about 18 hours a day among the sample households, somewhat higher than the reported average of 16 hours for the whole MWSS operation. Private waterworks have a lower record with an average of 15 hours of water availability and only 40% of the sample households received water 24 hours a day. In terms of water pressure, however, a greater proportion of households covered by private waterworks (32%) reports high water pressure compared to only 12% among MWSS households. Indeed, 40% of MWSS households suffer from low water pressure compared to 16% among households under private waterworks. Water pressure is moderate for about half of the households using both sources of water.

3.6 Water source and quality

By Asian standards, MWSS water is considered of relatively good quality (ADB 1993). It is potable, whereas tap water in Bangkok, Jakarta, and other parts of Asia cannot be directly used for drinking. Table 8 reports households' perceptions about the quality of water from the various sources. Except for the problem in turbidity, the sample households generally found their water to be of good taste, odorless, and clear. Since vended water is mostly MWSS water, there are no major differences in the perceptions for those measures between the two groups. In terms of turbidity, however, nearly all households using vended water complained about the presence of particles in the water. Indeed, both MWSS and groundwater extracted by private waterworks and individual tubewells are all characterized by turbidity problems as 80% to 85% of households observed particles in their water. The main difference in quality of water is in terms of taste between MWSS on the one hand, and private water works and individual tubewells on the other hand. Because individual tubewells are shallower than deep tubewells used by private waterworks, the taste of water from the former is generally even poorer.

4. COST OF WATER AND HOUSEHOLD INCOME

Because of the essential nature of water for human survival, the pricing of water is a politically sensitive issue. Officially, the price of MWSS water is set to recover the direct cost of water production. There has been no attempt to charge the scarcity value of water, nor the appropriate charge for use of groundwater. Yet, the MWSS continues to require direct subsidies from the central government for its investment program. Moreover, the water tariff structure is set in increasing blocks with a low lifeline rate to

favor low-income households (see Appendix Table 3). In addition, water charges for industrial and commercial users are about double those for household consumers. Are the poor really benefiting from such a pricing policy?

4.1 Price, income, and water source

Table 9 reports the average price, monthly income, and the percentage ratio of monthly water bill to income by source of water. The cost of water varied widely by source of water. Households with official MWSS connections pay the lowest price for water averaging ₱5.50 per cubic meter. In areas where a centralized sewer system exists, the cost of water and sewerage service is about ₱8.50 per cubic meter. Private waterworks charge a price that is slightly over 40% higher than MWSS average price without sewer. In contrast, vended water costs much higher, ranging from about ₱22 per cubic meter when indirectly buying MWSS water through plastic hose at fixed charges to as high as ₱72 per cubic meter for MWSS water delivered to the households.

The relevant comparison to make is between the price of water from an MWSS connection and MWSS water delivered by vending. That difference is about 13 times. While MWSS water[3] picked up from the other households is the more common mode of buying water among poorer households, the average price per cubic meter does not include the cost of time and effort to queue and carry the water from the source to the household, as well as the inconvenience of not having tap water. Even assuming a lower opportunity cost of labor among the poorer households, total cost of such vended water when those factors are considered may easily reach from P45 to P55 per cubic meter or 8 - 10 times more than the cost of water from an MWSS connection.

As also shown by Table 9, the average income of households with tap water from MWSS, private waterworks, and individual tubewells are significantly higher than households relying on vended water. For example, average income of households with MWSS connection is about three times that of households having to pick up the water from vendors. With the higher cost of water and lower incomes, poorer households have to spend a much greater proportion of income on water than wealthier households. Ironically, therefore, the poorer households without MWSS connections have to pay a much higher price for the same MWSS water at an even greater inconvenience.

4.2 Cost of water by income class

Table 10 further indicates the regressive nature of actual water price structure as the average price, water consumption, and ratio of water bill to income is presented by income class. Average price of water declines from about ₱36 per cubic meter for households with annual average income under ₱30,000 to only about ₱7 per cubic meter for households with incomes of over ₱1,000,000. Water consumption for the poor

[3] MWSS charges consist of 4 items: a) basic charge based on a progressive water rate structure as in Appendix Table; 3b) currency adjustment computed on per cubic meter of water consumed; c) environmental fee computed as 10% of the sum of the basic charge and currency adjustment cost (in areas where MWSS operates a central sewerage system, a sewerage charge of 50% is added to the environmental fee); and d) a small meter service charge fixed depending on the size of the water meter, i.e., ₱1.50 for meter size of 1/2 inch, ₱2.00 for 3/4 inch, and ₱3.00 for one inch.

average about 6 cubic meters per household, in contrast to about 90 cubic meters for the rich household. And the percentage ratio of water bill to income ranges from 0.6% to 8.2% for rich and poor households, respectively. Clearly, the progressive nature of the MWSS water tariff structure does not benefit the poor. Indeed, the low water price policy by limiting expansion of water supply, leads to water rationing that inevitably favors the rich over the poor.

Comparison of water rates among ASEAN countries is very instructive (Table 11). With the exception of Kuala Lumpur where 84% of capital investment is subsidized, MWSS has the lowest water charges, while Singapore has the highest. In practice, because the relatively poor in Manila cannot be provided with official MWSS water connections, these households end up paying a much higher price for water for lower quality of water service than the higher income households in Singapore ($14 per 10 cubic meter compared to $3.26 per cubic meter respectively) for better quality of water service.

5. WATER DEMAND FUNCTIONS

In this section, water demand function is estimated based on the cross-section household survey data. Empirical estimation of a water demand function provides: a) quantitative analysis of the factors affecting household demand for water; b) price elasticity estimates necessary for determining optimal pricing policies; and, c) basis for water demand projections in Metro Manila needed for investment planning.

5.1 Demand model and specification

Demand models are estimated separately for households dependent on vended water and households with MWSS connections. In both cases, simultaneity problems are encountered. For vended water, the price variable may be endogenous because price is determined by demand and supply factors. Although the use of household level rather than aggregate data may mitigate the problem, the fragmented nature of the water vending market makes individual household level decisions on water demand more likely to influence price. To avoid biased and inconsistent estimates with ordinary least squares regression, the demand functions for vended water are estimated by two-stage least squares. In the first stage, a price equation is estimated. In the second stage, predicted price is specified together with other explanatory variables in the demand equations.

The nature of the simultaneity problem is different for the sample of MWSS water consumers. Whereas the price of water is administratively determined in this case, water charges are characterized by an increasing block structure. Hence, while consumers choose the quantity of water purchased considering some measure of price, the price paid also depends on the quantity of water consumed. In the demand function for MWSS water, the effect of the price structure is represented by two variables instead of the usual average price (APRICE). These are the marginal price (MPRICE) and the difference between the actual water bill and what the bill would have been had all the water been bought at the marginal price (DIFFER) (see Deller et al 1986). Two-stage least square regression was also used to address potential simultaneity problems. Use of ordinary least squares can be expected to result in biased and inconsistent estimates. In this case, two equations where MPRICE and DIFFER are the dependent variables are

first estimated. Predicted MPRICE and DIFFER are then included in the demand equation in the second stage.

The dependent variable in the demand equation is the monthly household consumption of water in cubic meter. APRICE and MPRICE are in pesos per cubic meter. Other variables used are monthly household income in thousand pesos (INCOME); household size (HHSIZE); distance from source in meter (DISTANCE); dummy variables to indicate source of water, i.e., MWSS2 = 1 if MWSS and 0 otherwise, HOSEF = 1 if by hose at fixed charge and 0 otherwise, PKUPMS = 1 if picked from households with MWSS connection and 0 otherwise, PKUPDW = 1 if picked up from households using tubewells and 0 otherwise, PLFAUCET = 1 if picked up from public faucet and 0 otherwise; dummy variables to reflect quality of service, i.e., TRBDY = 1 if without particles and 0 otherwise, TASTE = 1 if water has good taste and 0 otherwise; and SMELL = 1 if water odorless and 0 otherwise; dummy variables to denote tenure of residence, i.e., RENT = 1 if renting house and lot and 0 otherwise, SQOWPV = 1 if squatting on private lot but owning house and 0 otherwise, SQRTPV = 1 if squatting on private land and renting the house and 0 otherwise, SQOWPL = 1 if squatting on public land and owning the house and 0 otherwise, SQRTPL = 1 if squatting on public land and renting the house and 0 otherwise; a dummy variable to represent households with booster pumps (BOOSTER) that is 1 and 0 otherwise; a dummy variable to denote MWSS sewer connection (SEWER) that is 1 and 0 otherwise; number of supply hours (HOURS); and respondent's number of years schooling (SCHOOL).

5.2 Econometric Results

Table 12 presents the estimation results of the demand equation for vended water in double log and linear forms, and estimated by ordinary least squares (OLS) and two-stage least squares (2SLS). In order to increase the degrees of freedom and improve the results, the demand model was also estimated by pooling households using vended water and a sub-sample of households using water within the 31 to 40 cubic meter block water tariff (see Table 13).

The regression results are remarkably good; the estimated coefficients have the expected signs and R^2s are relatively high for regressions using cross-section data. Almost 90% of the variations in demand are accounted for by the explanatory variables for the pool data. Except in the coefficients of the price variable, all their estimated values are similar across the various regressions.

Coefficients of average price, household income, and household size are expectedly all very significant. Dummy variables representing mode of vending water are also statistically significant. To some extent, these variables are capturing the effects of differences in total cost of water, for example, the opportunity and inconvenience of transporting water that is not adequately reflected in the average price. The coefficients for distance from source all have the correct negative signs and are significant in the 2SLS regressions. The same is true for the dummy variable for taste, which is significant in the 2SLS estimate of the linear specification, but not in others.

The 2SLS estimation is superior to the OLS not only in terms of the greater number of statistically significant variables. More importantly, it provided an unbiased

and consistent estimate of price elasticity of water demand. The OLS estimated price elasticity (-0.2) while significant is quite low, lower than estimates in Jakarta (Crane 1994), Hongkong (Woo 1993), and elsewhere (Moncur 1987; Agthe et al 1986; Deller et al 1986; Martin and Thomas 1986) which range from -0.4 to -0.8. The 2SLS estimate is much higher (-2.1) for the vended water sample only; for the pooled sample, the estimated price elasticity is within the range of estimates for other countries (-0.5). These results indicate a highly responsive demand function to changes in price which is not surprising to find among the generally low income households dependent on vended water. Such elastic price response suggests that pricing can be an effective means of managing allocation of limited water supply more efficiently.

6. CONCLUDING REMARKS

The findings from this household survey of water use indicate the following:

1. Failure by the public sector to provide an efficient (and equitable) system of supplying household demand for water under the MWSS service area.

A fairly large proportion (over 30%) of the population is not reached by any public water service. And within the service area, the quality of service in terms of hours served and water pressure has been quite poor. Nearly one third of households with MWSS connection receive water for less than 12 hours per day (and only 56% have day long water supply); while 40% of households suffer from low water pressure.

2. The lack of water connections throughout the water service area, inadequate water supply to those with water connections, and willingness to institutionalize provision of water among squatter households by MWSS have induced the development of private water vending activities. Ironically, over 80% of that privately vended water is MWSS water that is part of the non-revenue water, but paid for by household consumers at a much higher price than MWSS rates. Assuming that average water consumption of households using vended MWSS water (24% of households) is only 40% that of those with MWSS connections, and only about 10% of water produced is lost through illegal connections and tampered meters, MWSS may easily increase its revenues by at least 30% through management or institutional reforms with little investment capital. Casual observation indicates that private water vending of MWSS, as well as illegal connections and tampering of meters, are relatively obvious and thus cost of enforcement of rational water distribution policies should be minimal. For example, MWSS should be able to legally sell water directly or indirectly to squatter households. Doing so only increases non-revenue water, raises cost of water for poor consumers, and corrupts the MWSS bureaucracy. Under the present management or institutional arrangement, there appears very little incentive to address the very high NRW through improved management.

3. The government has decided that privatization of MWSS (i.e., contracting two private concessionaires to operate the MWSS) would be the best way to achieve the management reforms necessary to improve efficiency of public water delivery. However, the process of privatization should be made more transparent to ensure the most favorable terms of contract for the public. For example, this study suggests that potential

revenues of MWSS can be substantially raised with little additional cost. Yet, MWSS is already proposing to raise water rates before privatization in order to cover its operational cost. Clearly, by management reforms such as privatization, revenues may be increased and cost reduced substantially. However, there are no comprehensive and independent studies that are available to all contracting parties and the general public (who evaluates the value of such reforms). Of course, contracting parties are provided technical and financial information about MWSS operations and they will themselves do some additional studies. A fairly accurate estimation of the relative importance of the various NRW causes in various MWSS districts is one of the basic analyses that should be provided to all concerned. It is critical that independent analysts concerned only with the public interest should be allowed to monitor and evaluate the process of privatization.

4. It should be emphasized that despite privatization of MWSS operations, the government will continue to have some regulatory role in the pricing of water delivered by MWSS because of the natural monopoly elements in water production and delivery.

Apparently, there has been no major effort to develop estimates of marginal cost and marginal revenue of producing and delivering water in Metro Manila, considering the cost of supply, scarcity cost of water, and other environmental and health factors, among others. Early determination of socially optimal water pricing policy would also improve the quality of the contract for MWSS privatization. Also, there has been no effort to estimate the scarcity cost of groundwater and institutionalize a market based system of regulating groundwater use in Metro Manila, despite definitive studies of groundwater mining. Clearly, optimal management of water resources for urban use in Metro Manila should take into consideration the tradeoff in the use of surface water (MWSS) and groundwater (mostly private).

5. The MWSS has been trying to alleviate public concerns about higher water rates by proposing to raise water rates only at higher levels of consumption and for industrial establishments. A progressive and dual water rate structure has been justified in terms of equity and conservation objectives. The study indicated that the progressive rate structure has not really benefited the poor, and may have mostly encouraged households, commercial, and industrial establishments to tamper with meters or shift to groundwater use which may be more socially costly. The poor are paying much higher water prices (two to five times more) than the better off households who typically have MWSS connections, simply because the former do not have access to MWSS water connections. Most households with MWSS connections generally incur higher cost of water than the MWSS rates because they have often installed booster and tubewell pumps, and purchased supplementary water from private vendors. Even those who cannot afford additional water supplies also incur the higher cost involved in managing an intermittent supply of MWSS water.

The relevant issue to consider in setting water prices is not so much whether it will allow MWSS to cover its cost nor whether or not it is "affordable" (a very subjective concept). Rather, efforts must be made to determine the price level that will equate demand for water to the supply of water produced considering the marginal cost of extracting/delivering good quality water, scarcity cost of water, and other externalities involved in the production and consumption of water.

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Table 1. Coverage and measures of efficiency of service of public waterworks systems in the main cities of ASEAN countries, 1990

	Area (km^2)	Coverage area (%)	House connections (000)	Non-revenue water	Water availability (hrs/day)	Staff per 1000 connections
Manila*	1488	69	618	58	16	12.8
Bangkok	710	79	768	31	24	5.5
Jakarta*	286	25	243	57	19	10.2
Kuala Lumpur	180	100	105	37	24	1.8
Singapore	633	100	728	8	24	2.4

* With significant private water vending; other cities do not have any significant water vending

Source: Asian Development Bank (1993) Water Utilities Data Book, Manila

Table 2. Distribution of sample households by source of water, Metro Manila, 1995

	No. Of households	% of source households
MWSS (w/o sewer)	260	51.4
(w/ sewer)	31	6.1
Private waterworks (PWW)	25	4.9
Individual tubewell (TBW)	11	2.2
Public faucets (PF)	5	1.0
Private water vendors	116	22.9
MWSS water	96	19.0
Pick-up	52	10.3
Hose (container)	16	3.2
Hose (fixed charge)	22	4.3
Delivered	6	1.2
TBW water	20	3.9
Pick-up	14	2.8
Hose (container)	1	0.2
Hose (fixed charge)	4	0.8
Delivered	1	0.2
Combinations*	58	11.5
Total	506	100.0

* See Appendix Table 2 for further details.

Table 3. Distribution of sample households by water sources and tenure of residence, Metro Manila, 1995 (%)

					Water vendors			
Tenure	MWSS	PWW	TBW	PF	Delivered	HF	HC	PU
Own H & L	46	72	73	20	57	12	12	23
Rent H & L	23	24	18	-	-	8	-	5
Squatting on private land								
Own H	15	-	-	60	14	19	23	30
Rent H	5	-	-	-	-	3	12	9
Squatting on public land								
Own H	9	4	9	20	29	46	47	21
Rent H	2	-	-	-	-	12	6	12

* H = house; L = lot; Del = delivered by carts/bicycles/jeeps/trucks. HF = hose with fixed charges; HC = hose by containers; PU = pick-up by containers

Table 4. Distribution of sample households by water source and by annual household income by bracket, Metro Manila, 1995 (%)

					Water vendors			
Income class	MWSS	PWW	TBW	PF	Delivered	HF	HC	PU
Under P30,000	1	-	-	40	14	4	12	9
P30,000 - P39,999	6	4	-	20	14	12	6	12
P40,000 - P59,999	11	8	9	20	-	19	18	26
P60,000 - P99,999	25	4	9	-	29	42	29	41
P100,000 - P149,999	16	8	-	-	14	15	35	8
P150,000 - P199,999	14	12	18	20	29	4	-	3
P200,000 - P249,999	5	4	28	-	-	-	-	1
P250,000 - P449,999	13	36	9	-	-	4	-	-
P500,000 - P749,999	2	8	18	-	-	-	-	-
P750,000 - P999,999	4	-	-	-	-	-	-	-
P1,000,000 and above	3	16	9	-	-	-	-	-

Table 5. Distribution of sample households by water source and by levels of water consumption, Metro Manila, 1995 (%)

					Water vendor			
Water consumption (cu m/hh)	MWSS	PWW	TBW	PF	Delivered	HF	HC	PU
1 - 10	10	-	36	100	57	B5	71	79
11 - 20	23	16	27	-	29	15	24	21
21- 30	22	16	18	-	14	-	6	-
31- 40	15	16	-	-	-	-	-	-
41 - 50	9	12	9	-	-	-	-	-
51 - 60	8	12	-	-	-	-	-	-
61 - 70	5	4	-	-	-	-	-	-
71 - 80	3	-	-	-	-	-	-	-
81 - 90	2	4	-	-	-	-	-	-
91 - 100	1	8	-	-	-	-	-	-
Over 100	2	12	9	-	-	-	-	-
Average Consumption								
(cu m/hh)	34.7	52.8	25.7	5.5	11.4	6.9	8.9	6.8
(cu m/capita)	5.8	8.9	3.9	1.3	2.0	1.3	1.7	1.3

Table 6. Distribution of sample households by time availability of water from MWSS and private waterworks, Metro Manila, 1995 (%)

No of hours	MWSS	PWW
1 – 4	6	12
5 – 8	15	20
9 – 12	9	8
13 – 16	7	16
17 – 20	6	4
21 – 23	1	-
24	56	40
Average no. of hours	18	15

Table 7. Distribution of sample households by degree of water pressure in MWSS and private waterworks (PWW) connection, Metro Manila, 1995 (%)

Water pressure	MWSS	PWW
Low	40	16
Moderate	48	52
High	12	32

Table 8. Distribution of sample households by water source and by quality of water, Metro Manila, 1995 (%)

					Water vending			
Quality of water	MWSS	PWW	TBW	PF	Delivered	HF	HC	PU
Turbidity								
W/o particles	20	16	18	-	-	8	6	3
W/ particles	55	52	64	100	71	81	76	83
Inconsistent	25	32	18	-	29	11	18	14
Taste								
Good	94	88	73	100	86	100	94	98
Poor	5	4	27	-	14	-	6	2
Salty	1	8	-	-	-	-	-	-
Smell								
Odorous	87	100	91	100	100	96	94	98
Foul odor	5	-	9	-	-	-	6	1
Inconsistent	8	-	-	-	-	4	-	1
Color								
Clear	81	84	64	100	86	85	70	91
Rusty	6	-	18	-	-	-	18	1
Yellowish	8	12	9	-	14	11	-	5
Inconsistent	5	4	9	-	-	4	12	3

Table 9. Average price of water, income per capita, and ratio of water bill to household income by source of water, Metro manila, 1995

Average source	Monthly price (P/cu m)	% of water income (p/capita)	Bill to income
MWSS (w/o sewer)	5.53	2887	2.0
(w/ sewer)	8.52	5648	1.5
Private waterworks (PWW)	7.92	7249	1.9
Individual tubewell (TBW)	n.a.	5031	n.a.
Public faucets (PF)	0	729	....
Water vendors			
MWSS water			
Pick-up	30.45	1168	4.2
Hose (container)	48.29	1223	6.2
Hose (fixed charge)	21.80	1325	2.7
Delivered	71.93	1359	11.9
TBW water			
Pick-up	40.16	854	5.7
Hose (container)	44.00	2500	4.8
Hose (fixed charge)	58.90	2245	3.8
Delivered	62.32	1850	4.3

n.a. = not available
.... = not applicable

Table 10. Average price of water, water consumption, and ratio of water bill to income by annual household income, Metro Manila, 1995 (%)

		Water consumption		
Income class	Average price (P/cu m)	(cu m/hh)	(cu m/capita)	% water bill to income
Under P30,000	36.38	6.0	1.6	8.2
P30,000 - P39,999	15.89	14.3	3.2	4.4
P40,000 - P59,999	15.88	18.4	4.0	4.2
P60,000 - P99,999	15.92	19.5	3.7	2.9
P100,000 - P149,999	13.94	26.0	4.0	2.2
P150,000 - P199,999	9.16	32.0	4.8	1.6
P200,000 - P249,999	5.94	38.5	5.8	1.4
P250,000 - P449,999	8.04	36.1	5.4	0.8
P500,000 - P749,999	6.04	63.9	7.8	0.8
P750,000 - P999,999	9.27	71.4	13.6	0.8
P1,000,000 and above	7.14	90.2	13.4	0.6

Table 11. Structure of water tariffs for household and grant element of capital investment in public waterworks system in ASEAN countries,1990

	Cost of water ($)				Grant element of capital investment (%)
	10 m^3	20 m^3	30 m^3	40 m^3	
Manila	1.05	2.32	3.87	8.07	22
	(1.44)*	(3.13)	(5.12)	(10.32)	
Bangkok	1.57	3.14	4.71	8.15	Nil
Jakarta	1.72	4.18	7.38	15.76	<1%
Kuala Lumpur	0.99	1.58	2.97	5.75	84
Singapore	3.26	6.52	11.13	22.50	Nil
		(7.82)	(13.36)	(27.00)	

* Figures in parenthesis show the total charges. For Manila, this includes a currency adjustment factor, an environmental fee of 10% of the tariff plus the currency adjustment factor, and a P2.00 flat meter service fee. For Singapore, this includes a water conservation charge of 5% on all consumption above 20 cu. m. The authors do not have any information at this time if similar surcharges are levied in Bangkok, Jakarta, and Kuala Lumpur.

Source: Asian Development bank (1993). Water Utilities Data Book. Manila

Table 12. Regression estimates of water demand functions based on households using vended water (including free public faucets), Metro Manila, 1995

	Log-log		Linear	
	OLS[1]	2SLS[2]	OLS[1]	2SLS[2]
APRICE	-0.159**	-2.092*	-0.056***	-0.484**
	(-2.47)	(-1.71)	(-3.91)	(-2.20)
INCOME	0.255***	0.254***	0.303***	0.294***
	(3.26)	(3.17)	(3.19)	(2.86)
HHSIZE	0.370***	0.411***	0.400***	0.424***
	(3.90)	(3.93)	(2.97)	(2.88)
HOSEF	-0.530***	-2.464*	-6.204***	-23.627**
	(-2.65)	(-1.90)	(-3.99)	(-2.53)
HOSEC	-0.283	-1.063*	-3.227**	-11.396**
	(-1.40)	(-1.83)	(-2.09)	(-2.42)
PKUPMS	-0.397*	-2.016*	-5.485***	-21.588**
	(-1.91)	(-1.85)	(-3.65)	(-2.50)
PKUPDW	-0.182	-0.257	-2.718**	-5.896***
	(-0.90)	(-1.17)	(-2.07)	(-2.65)
PLFAUCET	-0.950**	-8.845*	-8.778***	-38.111**
	(-2.47)	(-1.76)	(-4.05)	(-2.48)
DISTANCE	-0.064	-0.074	-0.016	-0.020
	(-1.48)	(-1.63)	(-1.35)	(-1.55)
TRBDY	0.107	0.094	1.166	0.475
	(0.96)	(0.79)	(1.34)	(0.51)
TASTE	0.123	0.891	2.343	8.156**
	(0.46)	(1.34)	(1.16)	(1.96)
SMELL	-0.401	-	-3.894**	-
	(-1.56)	-	(-2.00)	-
Intercept	0.393	7.092	12.31***	32.62***
	(0.433)	(1.57)	(4.04)	(2.70)
R2	0.449	0.418	0.444	0.366
DW	1.916	1.893	1.965	1.887

***significance at 1%,
**significance at 5%,
*significance at 10%.

[1] Other variables included but insignificant and not shown are measures of tenure of residence, age, and years of schooling of respondent.

[2] Other variables included, but insignificant and not shown is the number of toilets.

Table 13. Regression estimates of water demand functions based on households using vended water, (including free public faucets) and MWSS water (within 31 to 40 cu. m. Block), Metro Manila, 1995

	Log-log		Linear	
	OLS[1]	2SLS[2]	OLS[1]	2SLS[2]
APRICE	-0.172***	-0.492***	-0.057**	-0.371***
	(-3.06)	(-7.58)	(-3.85)	(-16.82)
INCOME	0.154***	0.173***	0.066*	0.076**
	(2.97)	(3.03)	(2.03)	(1.99)
HHSIZE	0.303***	0.351***	0.294***	0.460***
	(4.08)	(4.33)	(2.62)	(3.67)
MWSS2	0.729***	-	19.557***	-
	(3.56)	-	(11.85)	-
HOSEF	-0.568***	-0.851***	-6.564***	-19.210***
	(-3.28)	(-6.73)	(-4.17)	(-19.23)
HOSEC	-0.321*	-0.419**	-3.625**	-9.575***
	(-1.83)	(-2.56)	(-2.31)	(-7.25)
PKUPMS	-0.426**	-0.642***	-5.947***	-17.797***
	(-2.35)	(-4.49)	(-3.94)	(-18.81)
PKUPDW	-0.166	-0.155	-2.962**	-5.508***
	(-0.95)	(-0.85)	(-2.24)	(-4.01)
PLFAUCET	-1.089***	-2.329***	-9.386***	-30.875***
	(-3.26)	(-9.05)	(-4.23)	(-17.40)
DISTANCE	-0.074**	-0.085***	-0.017	-0.015
	(-1.97)	(-2.19)	(-1.43)	(-1.22)
TRBDY	0.062	0.059	0.180	0.189
	(0.78)	(0.69)	(1.25)	(0.25)
TASTE	0.058	0.073	1.353	4.355***
	(0.28)	(0.38)	(0.75)	(2.75)
SMELL	-0.188	-	-1.886	-
	(-1.14)	-	(-1.29)	-
Intercept	1.443	2.153	14.317	29.29***
	(2.22)	(3.17)	(5.20)	(11.84)
R2	0.838	0.818	0.942	0.920
DW	1.968	1.937	2.036	2.004

*** significance at 1%,
**significance at 5%,
*significance at 10%.

[1] Other variables included but insignificant and not shown are measures of tenure of residence, age, and years of schooling of respondent.
[2] Other variable included, but insignificant and not shown is the number of toilets.

Appendix

Table 1. Location and number of household demand survey for water in Metro Manila, 1995

Cities/municipalities	No. of barangays	No. of households
Manila City	20	87
Quezon City	23	142
Makati City	13	59
Pasig City	10	72
Caloocan City	11	88
Paranaque	4	30
Mandaluyong	5	10
Pasay City	4	7
Las Pinas	2	6
Cainta	2	2
Taguig	1	3
Total	95	506

Table 2. Distribution of households in the National Capital Region (NCR) by source of water, 1990[a]

		MWSS/CWS[c]		Piped deep well			
	No. of sample	Own	Shared	Own	Shared	Vendors[e] (000)	Others[f]
NCR[b]	1570	55	28	4	7	5	1
Kalookan	151	48	28	6	14	1	3
Manila	309	64	31	1	1	3	0
Pasay	74	52	36	2	2	7	3
Quezon City	332	59	25	4	9	2	1
Las Pinas	58	40	20	15	15	7	3
Makati	89	62	28	2	2	5	1
Malabon	58	54	35	1	3	5	2
Mandaluyong	50	63	33	2	1	1	0
Marikina	60	65	23	4	5	2	1
Muntinlupa	54	39	21	16	20	1	3
Navotas	39	45	36	1	2	15	1
Paranaque	61	49	23	7	8	11	2
Pasig	78	59	30	2	2	7	0
Pateros	10	50	29	2	1	18	0
San Juan	24	78	21	1	0	0	0
Taguig	53	21	22	12	24	12	9
Valenzuela	70	35	26	8	20	9	2

[a] Based on a 10% sample of total households in the National Capital Region

[b] National Capital Region

[c] Metropolitan Waterworks and Sewerage System, and Community Water System typically using deep tubewells.

[d] Individual or shared (few HH) piped deep tubewells.

[e] Refers to households solely dependent on water vendors

[f] Shallow well, dug well, spring, lake, river, rain, etc.

Source: National Census and Statistics Office

Table 3. MWSS water tariff schedule as of May, 1992

Consumer type consumption volume	Rate
Residential A	
First 10 cu. m.	P 28.00/conn.
Next 10 cu. m.	3.40/cu. m.
First 10 cu. m.	4.15/ cu. m.
Next 10 cu. m.	5.20/ cu. m.
First 10 cu. m.	6.00/ cu. m.
Next 10 cu. m.	6.55/ cu. m.
First 20 cu. m.	7.25/ cu. m.
Next 20 cu. m.	7.90/ cu. m.
Over 100 cu. m.	8.45/ cu. m.
Residential B	
First 10 cu. m.	P 33.50/conn.
Next 10 cu. m.	4.10/ cu. m.
First 10 cu. m.	4.65/ cu. m.
Next 10 cu. m.	5.40/ cu. m.
First 10 cu. m.	6.10/ cu. m.
Next 10 cu. m.	6.65/ cu. m.
First 20 cu. m.	7.45/ cu. m.
Next 20 cu. m.	8.00/ cu. m.
Over 100 cu. m.	8.55/ cu. m.
Commercial	
First 25 cu. m.	P 226.25/conn.
Next 975 cu. m.	9.05/ cu. m.
Over 1000 cu. m.	9.50/ cu. m.
Industrial	
First 25 cu. m.	P 246.25/conn.
Next 975 cu. m.	9.85/ cu. m.
Over 1000 cu. m.	11.55/ cu. m.
Overall average	P 6.43/cu. m.

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